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rendezvous

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... **New Age of Flight**

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COVER: Man's dream of free flight, from Dae-dalus to the Jet Belt, is illustrated by E. W. Donovan II.

The Vietnam Lesson--Airpower

THE most important lesson perhaps that is coming out of the Vietnam war is the vastly expanded role of airpower in limited conflicts and, especially, in the type of counterinsurgency warfare being waged in Vietnam.

That is the opinion of Gen. John P. McConnell, Air Force Chief of Staff, expressed at the Air Force Association Convention in Atlanta earlier this year.

Among the wide-ranging tasks of airpower in Vietnam are close air support of troops, attacks on enemy concentrations and supply lines, aerial reconnaissance and the vital airlift effort.

"The vital contributions of airpower in these and related areas can be evaluated fully only by the historian, long after the end of the Vietnam war when sufficient data will have become available to permit an objective and fair assessment," the general said.

He said the following conclusions, however, can be drawn at this stage:

1. If it had not been for the expanding and effective employment of airpower, our losses of men would have been far higher. The U.S. could not have maintained its operations at required levels, and without airpower a communist victory in South Vietnam probably could not have been prevented.

2. In the accomplishment of its mission, the Air Force has evolved new equipment, new applications and new tactics which will greatly enhance its ability to deal with similar conflicts in the future, both politically and militarily.

3. In view of the importance of airpower in limited conventional conflicts, the nation must strive for dramatic new orders of military capability in tactical and strategic airpower just as the C-5A (giant cargo aircraft) will achieve in the airlift field.

Gen. McConnell also had this warning:

"I have the impression that many people in this country take our still-existing nuclear superiority for granted and, in fact, place less and less importance on its preservation.

"The reason may be that our strategic nuclear strength has achieved its primary purpose of deterring nuclear aggression for so long that the threat of it has lost much of its initial frightfulness.

"In my opinion, such complacency is extremely dangerous because of the still-growing nuclear strength of the Soviets and the nuclear potential of such aggressive nations as Communist China.

"I submit that there can be no more urgent task for the continuing protection of our national security than to maintain our margin of nuclear superiority in the face of any advances potential aggressors may make."

He said that development of new highly-advanced manned strategic aircraft is necessary for "a convincing two-pronged nuclear deterrent." That means bombers to succeed the B-52.

"My challenge to you and to all our fellow citizens," said Gen. McConnell, "is to help forge the superior weapons of tomorrow that will discourage aggression at all levels and thus bring us ever closer to our ultimate goal of a secure peace for all the peoples of the world." ■



General John P. McConnell has a distinguished military career which began in 1932 with his graduation from West Point. A fighter pilot during his early military days, he became Chief of Staff of the China-India-Burma Air Force Training Command at Karachi, India in 1943 and remained in Asia for the rest of the war. While serving as deputy commander of the Third Tactical Air Force in 1944, he participated in combat operations against the Japanese. He held several command positions following the war, and in 1962 was assigned to Europe as Deputy Commander in Chief of the U.S. European Command. Gen. McConnell became Vice Chief of Staff of the U.S. Air Force in 1964, and assumed his present position on Feb. 1, 1965.



What's up in **space?**

The wide scope of the space effort was reviewed earlier this year at the Fourth International Symposium on Bioastronautics and the Exploration of Space in San Antonio, Texas. Here are three reports from that conference.

Technology: Father of Human Welfare

THE direct importance of the space effort to the nation's welfare was stressed earlier this year by the keynote speaker at the Fourth International Symposium on Bioastronautics and the Exploration of Space.



"Every major power and every nation eager to raise its standard of living and world influence strives to participate in space technology and space exploration," said Edward C. Welsh, executive secretary of the National Aeronautics and Space Council, before the meeting in San Antonio, Texas.

"It certainly would be ironic," he said, "if the United States, as the world's leader in international coop-

eration and the world's leader in standard of living, were to abandon or even neglect the source of such strength.

"I believe it might be labeled the worst mistake in history. The national and international effects would be disastrous. I hasten to state that I do not believe we will make that mistake."

He urged everyone at the symposium to do "an even better" job of educating the nation and the world on the importance of the space effort.

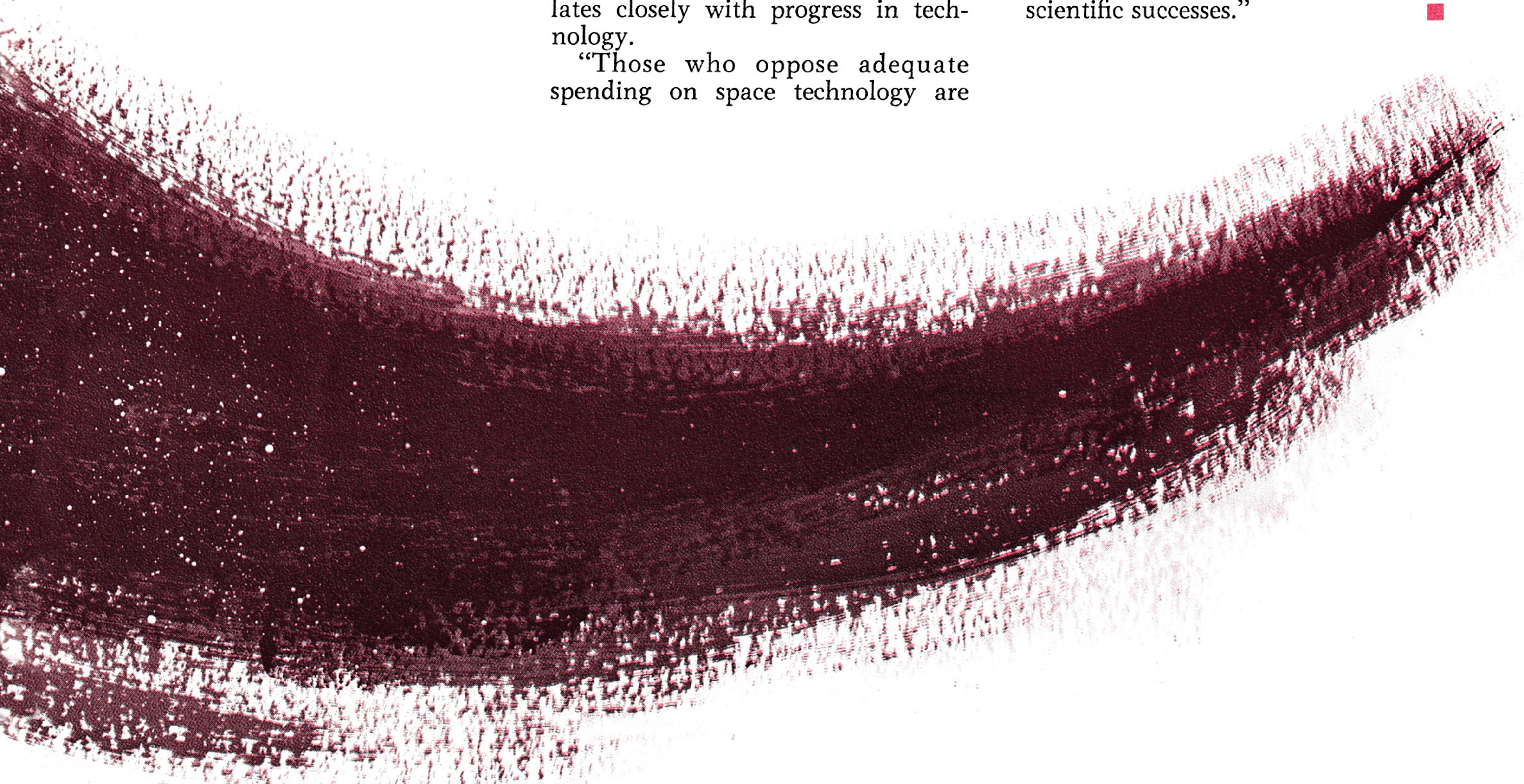
Earlier, Welsh said location or natural assets are not the prime reason for the high standard of living in the U.S., "but rather because of (the nation's) employment of technology in making effective use of its human and natural resources. Again, I suggest that you look about the world and note that where there is progress in human welfare it correlates closely with progress in technology.

"Those who oppose adequate spending on space technology are

deliberately or inadvertently campaigning for a lower standard of living for our people, a declining Gross National Product for our nation and a secondary position in strength to that of the Soviet Union."

He quoted Vice President Hubert H. Humphrey as follows:

"The people who don't explore today find themselves without the ingredients of progress for tomorrow. This great economy of ours is not the product of accident. The so-called technological gap, even between ourselves and other developed nations, is not just good luck on our part or bad luck on theirs. The investment that this nation has made, both public and private, in men and materials in the fields of science and technology, and particularly in all of the related fields that surround our space exploration, has contributed immensely to our technological and scientific successes." ■



Putting Comfort in Orbit

AT the same conference, the logic of building space stations was explained by Dr. Robert R. Gilruth, director of NASA's Manned Spacecraft Center, Houston, Texas.



Besides serving as a space "base"—equivalent in function to those in the Antarctic—Dr. Gilruth said the stations will provide a number of benefits.

"Both the equipment required to support man and to run the station and the basic scientific equipment which we place in space can operate for a long lifetime.

"With proper logistics support, these items can be reused, can be refurbished where wearout phenomena or random failures have occurred, and perhaps more importantly, can be modified to take advantage of gains in technology or changes in experimental objectives," he said.

Dr. Gilruth added:

"The creation of a permanent place in space to which we return again and again allows us to centralize the storage of expendables and equipment and to make maximum use of a limited number of logistics

flights.

"Since logistics flights are the largest single cost element in any orbital program, this is an extremely important economic advantage of space station operation."

Among other advantages:

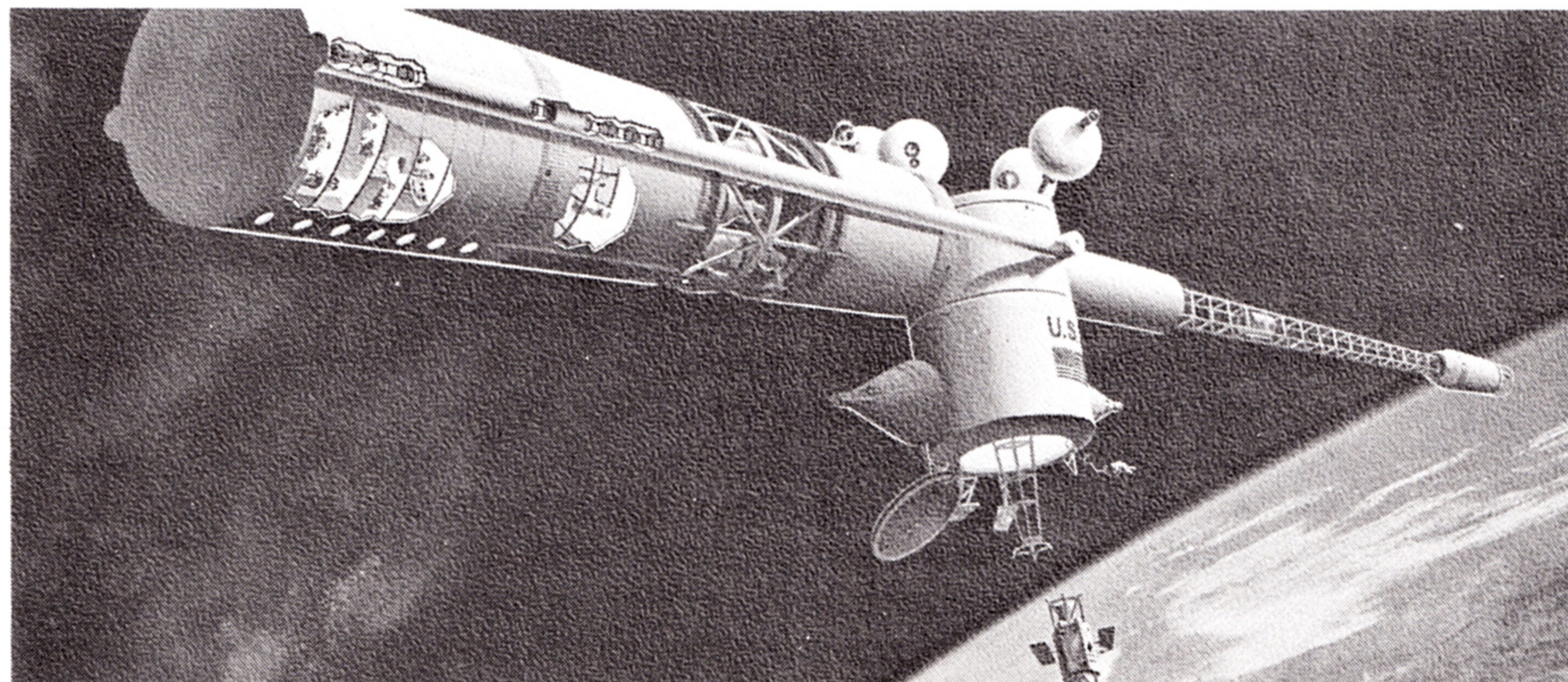
1. Crew sizes of more than 10 to 12 persons will allow more time for work on experiments, since only a small part of the total crew work-time will be needed to operate the station.

2. Larger crews will also allow more specialists to experiment in space. "This will relieve the considerable cross-training problems which are inherent in small crews," said Dr. Gilruth.

3. Bigger living facilities in space will provide more Earth-like conditions, improving crew efficiencies and reducing the training requirements.

4. A space station will also have a large power system, using either nuclear or solar cells.

"The capability of a space station to carry power sources of 20 to 50 or even 100 kilowatts will be its most important technical contribution, since the availability of power is the basis of all system design and is fundamental to the capability of nearly all experimental equipment," Dr. Gilruth said. ■



The Lookout for Life

IS anybody there?

That's one of the key questions in the minds of space scientists when they look at the sky, and it's going to be a tough one to answer.



The scope of the effort—finding life on other planets—was described in San Antonio by Dr. Harold P. Klein, assistant director for Life Sciences, NASA Ames Research Center.

For this generation, Mars is the most likely spot for finding life. Billions of other stars probably have solar systems, but the distances to them are dazzlingly immense.

"Will man be able to span the tremendous distances involved?" asked Dr. Klein.

"While the stars closest to the Sun are about four light years away, it has been pointed out that within the immediate vicinity of our solar systems, stars about 10 light years away might be of more potential interest from the point of view of extraterrestrial life.

"To reach such a star would, of course, require a rocket system that could escape our solar system. Such a rocket is well beyond our present capability, since a speed of 18 miles per second would be required.

"A system of this type traveling to one of the stars of interest, 10 light years away, would take about 100,000 years to reach the star and another 100,000 years to make the trip back to Earth."

Dr. Klein reviewed some of the massive technological problems involved in boosting space flights to speeds required for interstellar space travel. He said it is almost certain that "for all practical purposes we

will be restricted in our space travels to the solar system."

The moon, which will probably be the first extraterrestrial body to be explored by man, holds little chance of supporting life.

"The present lunar physical characteristics—lack of an atmosphere, both very high (daytime) and low (nighttime) temperatures, and the high ultraviolet flux—would seem to rule out the moon as a likely abode of life," he said.

Of the planets, Mars is considered the best available target in the search for life. Here is what scientists already know about Mars:

—It is half the size of Earth, and has one-tenth the mass of Earth.

—Its temperatures are about 50 degrees colder than Earth, rising only to 30 degrees centigrade for a few hours per day during the Martian summer near the planet's equator.

—The Mars atmosphere is about 1/100th the pressure of that on Earth. Its main component is probably carbon dioxide.

—The amount of water in the Martian atmosphere is estimated at 1/1000th that of the Earth.

Dr. Klein said the Mariner IV fly-by produced a large amount of information about Mars, but he added:

"Mariner IV did not, and could not, settle the question of the presence of life on Mars. It did, however, corroborate or extend many of our estimates of the physical characteristics of that planet."

And while the Martian environment is bleak by Earth standards, Dr. Klein said that "if the biologist is impressed by any overriding property of terrestrial life, it is by the adaptability of organisms."

He noted:

"Organisms, particularly microorganisms, are found to grow under such widely divergent conditions as

in boiling springs of Yellowstone Park, where the temperatures are constant at about 96 degrees centigrade and in perpetually frozen lakes of Siberia."

And modern astronomers argue that Mars may have been warmer at one time, and that it contained a heavier atmosphere than at present.

"Under such conditions," said Dr. Klein, "the development of living forms, once started, could have proceeded under more favorable conditions than exist on Mars at present."

"Based on analogy with terrestrial life, then, it is not unreasonable to imagine that evolutionary adaptive processes on that planet could have selected organisms with increasing resistance to dehydration, to lower temperatures, to higher ultraviolet fluxes and so forth, as Mars slowly and over long periods of time began to lose its atmosphere."

There is also the possibility that life on Mars will be a different *type* than that on Earth. (All Earth organisms, while greatly diverse, are fundamentally similar.)

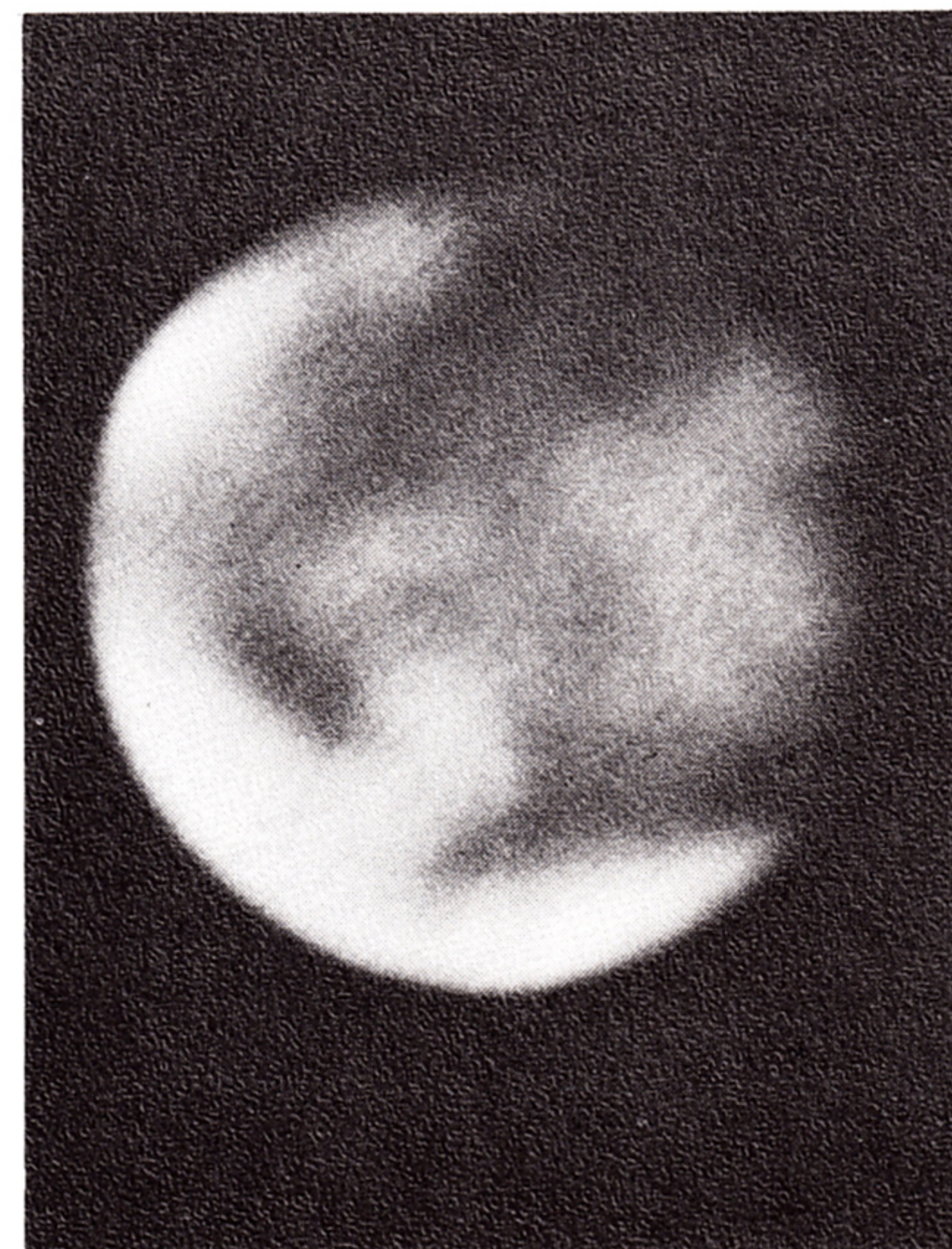
"Clearly," said Dr. Klein, "if living organisms are found on another planet, and if they are found to have properties uniquely different from organisms in the 'terrestrial class,' our concept of life would be significantly broadened."

"Indeed, even if life is not found elsewhere, particularly on planets where the environmental conditions are not thought to be inimical to living organisms, we would have much to think about in trying to explain the absence of life there."

"New hypotheses about the origin of terrestrial life would almost certainly emerge in this case."

Dr. Klein concluded by quoting the Space Science Board of the National Academy of Sciences as follows:

"The biological exploration of Mars is a scientific undertaking of the greatest validity and significance. Its realization will be a milestone in the history of human achievement. Its importance and the consequences for biology justify the highest priority among all objectives in space science—indeed in the space program as a whole."



Public Health Goes Space Age

The nation's first computerized public health program could be a proving ground for a national health project.



At left, a Public Health nurse visits an Indian family. Above is the Public Health Service complex in Tucson.



MEDICINE joined hands with space age technology this year to develop the nation's first computerized public health system, which is being designed for 8,500 Indians of the San Xavier and Papago Indian Reservations in Arizona.

Sponsored by the Health Program Systems Center of the Division of Indian Affairs, the system will gather medical facts on the tribe to facilitate their treatment. If successful, the project may be expanded to include all 400,000 American Indians and Alaskan natives. Eventually, the Department of Health, Education and Welfare could use it to bring better public health to everyone in the nation.

The prime contract for the project, totaling \$160,000, was awarded to Bell Aerosystems' Arizona Operations, based in Tucson. Working with Bell is Health Research Inc. at the famed Roswell Park Memorial Institute of Buffalo, N. Y.

The Papago Indians, who are among the poorest in the Southwest, are an ideal starting place for the health program. Since their land is barren, they move from place to place in search of work.

When a Papago needs medical treatment, he can go to one of several area clinics or hospitals. Very often, the clinic must trace his entire health record and give him a complete physical examination—even though another clinic nearby may have the same information from a previous visit by the same Indian.

It is difficult for the various clinics to exchange information on the wandering Indians because Papagos change their names frequently, taking whatever name suits them from time to time.

In addition, they may not remember the name of the disease for which

they are being treated, or when they last received medical treatment.

To solve the problem, data about each member of the tribe will be filed in a central computer located at Bell's computer center in Tucson. Access to the automated files will be possible through remote terminals located at the San Xavier and Santa Rosa medical clinics, and at the Sells Hospital and out-patient clinic.

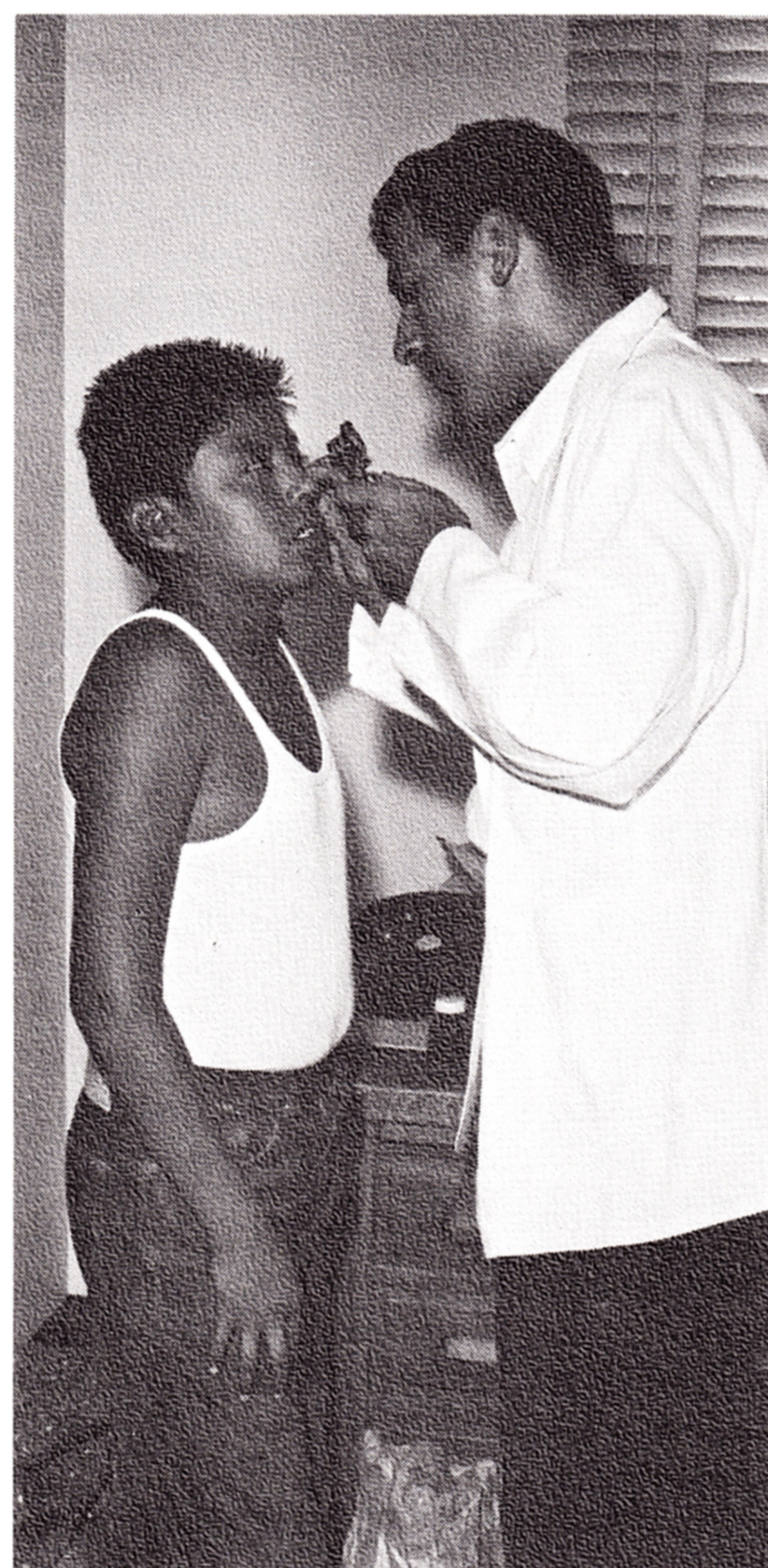
Considered the most modern computer complex in Southern Arizona, the Bell facility includes a third-generation Model 3300 computer leased from the Control Data Corp. of Minneapolis, Minn. Much of its time is spent handling data for the U.S. Army's electromagnetic compatibility and frequency spectrum management programs.

The health system will provide physicians, public health nurses and environmental specialists with a single data base that is current, complete and immediately available regardless of the location at which the patient is being treated.

The automated records system will also provide the means of detecting and analyzing health problems on a family and community basis fast enough to prevent the outbreak of communicable diseases.

The 18-month development is under the guidance of James E. Miller of HEW's Division of Indian Health. Dr. Alfred E. Garratt, of Bell's Arizona Operations, is project director, with Dr. Robert K. Ausman, executive director of Health Research Inc., as associate director.

Although the initial system is experimental in nature, it will provide a basic, operational information system by the end of the 18 months. Then, it could be expanded to include even greater capabilities. ■



Young Indian boy receives an eye examination.



Bell Aerosystems' Arizona computer complex, where health information will be stored.

ONE by one the conversations stopped as the bus rolled toward the dark opening in the side of the mountain.

The civilians had been through tunnels before, but never one like this pipeline to an underground city. The air was damp and the exhaust echoed against the granite walls.

After about a third of a mile the bus halted before a pair of giant steel doors. The group disembarked and walked the rest of the way, stopping now and then to take a photograph.

"Welcome to NORAD," said a red-haired Air Force colonel when the group took seats in a conference room.

With cool precision, the colonel and other officers—including an officer of the Canadian Forces—described the job of NORAD, the North American Defense Command. This organization uses exotic electronic devices to keep watch on the sky. If attack comes, the warning to North America's 220-million citizens will come from NORAD.

The underground outpost where U.S. and Canadian air defense experts stand vigil is a city of steel buildings that rest on spring foundations inside Cheyenne Mountain, near Colorado Springs, Colorado.

It is one of several impressive stops along the route of the U.S. Army Air Defense Command's 12-year-old "Operation Understanding" program. An award-winning community relations project, Operation Understanding gives community leaders from across the nation a firsthand look at the U.S. air defense effort.

A key part of the program are frequent question and answer sessions, in which civilians get answers that might be valuable in the future, when a new missile or defense system is deployed by the Army.

An Operation Understanding group from Kansas City and the Buffalo-Niagara Falls area was flown last spring to El Paso Texas, home of Fort Bliss and the starting point for the tour. In the next five days they traveled to McGregor Missile Range, White Sands Missile Range, NORAD and the U.S. Air Force Academy at Colorado Springs.

A giant base covering more than a million acres and manned by more than 30,000 soldiers, Fort Bliss is a fitting place for the start of the understanding tour. It is the location of the U.S. Army's Air Defense School, and McGregor Range adjacent to Fort Bliss is where missilemen assigned to protect U.S. cities train daily in the latest weaponry.

At Bliss, the visitors were greeted by Major General G. V. Underwood, Jr., then commander of the Air Defense Center. The general, who said

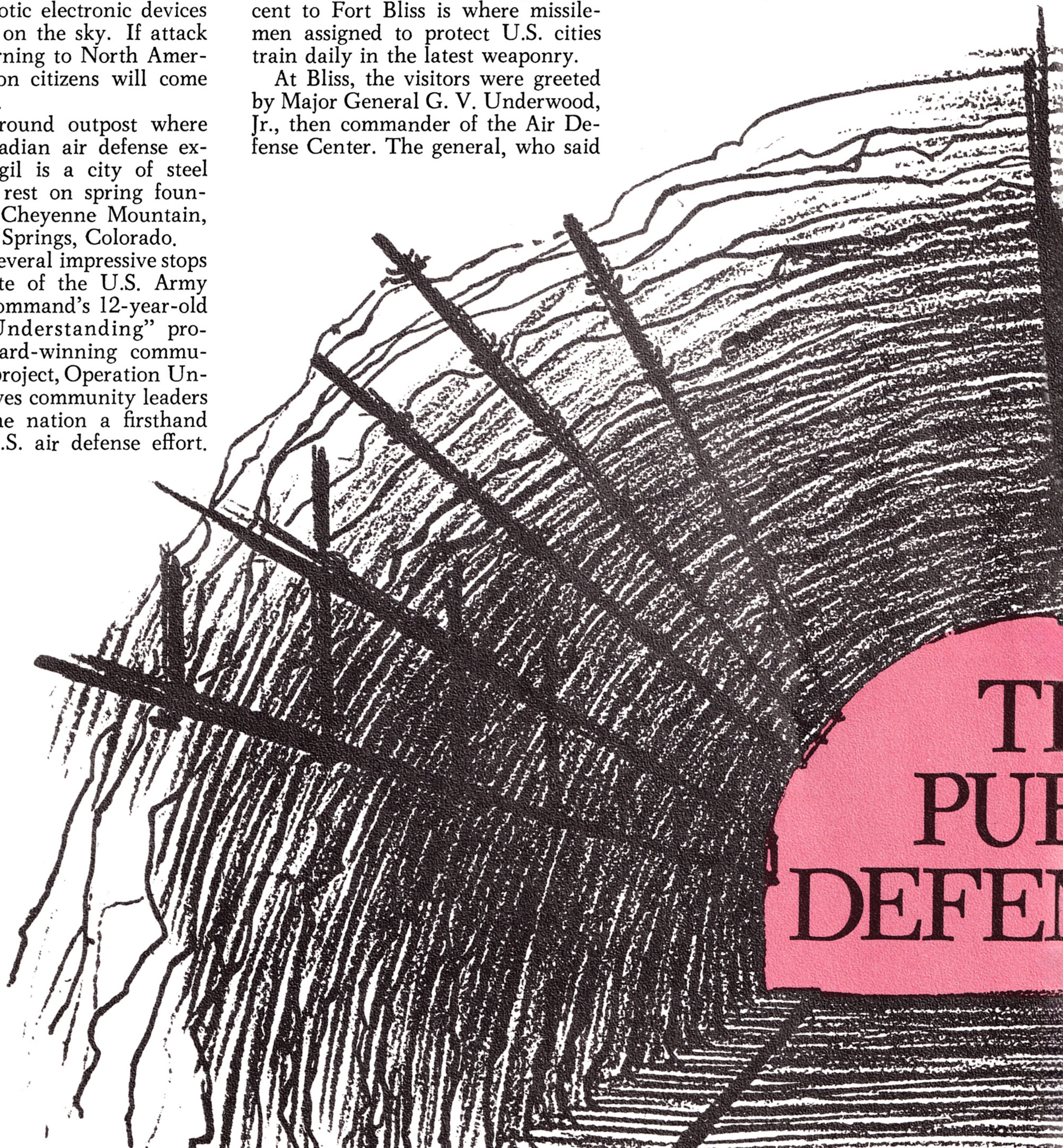
he had a special affection for the Buffalo area, where he once served as air defense commander, described how advanced air defense had become since World War II's anti-aircraft guns.

[Gen. Underwood became a lieutenant general last summer, and succeeded Lt. Gen. Robert Hackett, who retired as commander of the Army Air Defense Command.]

"This year to date," he said, "our missile firings have been 88 per cent effective. Compare this to the 2 to 3 per cent kill probability in World War II and Korea. The kill probability now? You guess."

Gen. Underwood listed several missiles being used or under development for air defense. They are:

1. The Nike family of missiles,



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which ground crews guide to their targets. The latest of these is the *Nike Hercules*, which exceeds the old Nike Ajax in range and high- and low-altitude performance.

2. The *Hawk*, designed to provide low-altitude protection, especially for ground troops. It has destroyed targets at altitudes as low as 500 feet and has scored a direct hit on a target drone going more than 1,500 miles per hour at over 30,000 feet altitude.

3. *Sprint*, an antiballistic missile that is under development. A two-stage, solid-propellant missile, *Sprint* is capable of carrying a nuclear warhead. It has the highest acceleration of any guided missile ever developed by the Army.

4. *Spartan*, also in development,

is a three-stage missile with solid fuel. With an atomic warhead capability, *Spartan's* first two stages provide boost, while the third stage contains the warhead and controls.

5. The *M42*, a lightly armored, full tracked vehicle carrying twin 40-millimeter cannon and a .30 caliber machinegun. Primary target for this system is medium- and low-flying aircraft.

6. *Redeye*, a one-man antiaircraft missile fired from a pipe that looks like a World War II bazooka. It is a low altitude defense weapon designed to protect front-line troops.

7. *Chaparral*, which is in development, is a modification of the U.S. Navy's Sidewinder. It uses a passive infrared homing system to intercept its target.

8. *Vulcan*, an automatic 20-millimeter gun mounted on a tank-like vehicle. It can fire 3,000 rounds per minute, filling the air with aircraft-destroying projectiles, or it can fire 500 rounds per minute against ground targets.

In response to questions, the Army stressed several times that none of

the above missiles can protect North America from a Russian Intercontinental Ballistic Missile (ICBM) attack. The threat of ICBM retaliation from the U.S. exists as a guard against Russian missiles.

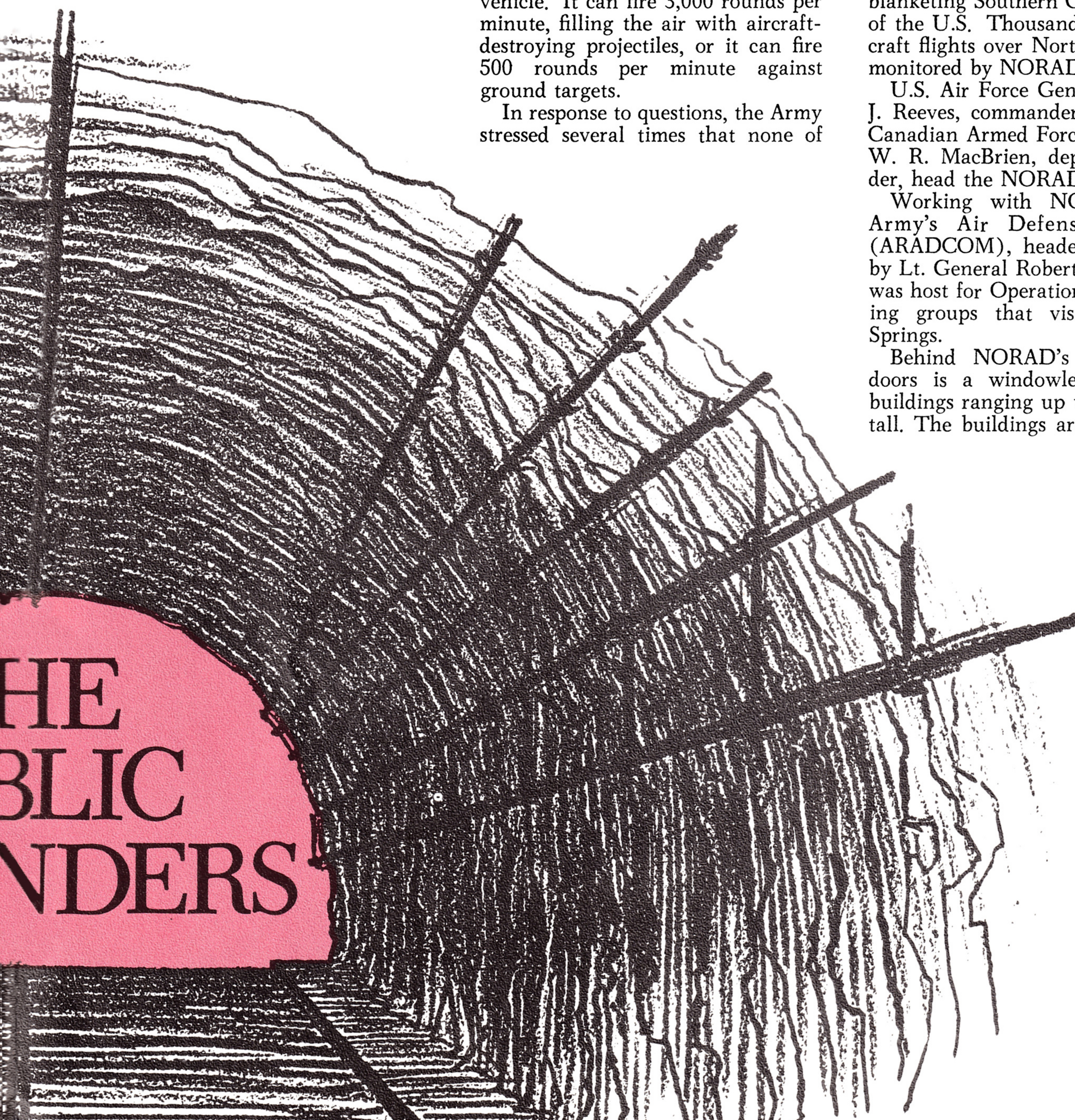
The Sentinel antiballistic missile system, however, is being developed to provide protection against future ICBMs that might be developed by Communist China. Otherwise, the U.S. air defense program is aimed primarily against attacking aircraft.

Keeping track of aircraft flights is the NORAD mountain complex, which went into full operation underground earlier this year. In Cheyenne Mountain, a force of 900 men controls the Distant Early Warning (DEW) line, the Ballistic Missile Early Warning Systems (BMEWS), the Space Detection and Tracking System and a network of radars blanketing Southern Canada and all of the U.S. Thousands of daily aircraft flights over North America are monitored by NORAD.

U.S. Air Force General Raymond J. Reeves, commander-in-chief, and Canadian Armed Forces Lt. General W. R. MacBrien, deputy commander, head the NORAD force.

Working with NORAD is the Army's Air Defense Command (ARADCOM), headed at the time by Lt. General Robert Hackett, who was host for Operation Understanding groups that visited Colorado Springs.

Behind NORAD's 30-ton blast doors is a windowless city of 11 buildings ranging up to three stories tall. The buildings are unconnected



except for flexible vestibules, and they rest on huge springs to guard against earth shocks that could disable electronic equipment.

Started in 1961, contractors used more than a million pounds of explosives to remove more than a million tons of granite from the mountain. The main excavation consists of three chambers 45 feet wide, 60½ feet high and 588 feet long, crossed by three chambers 32 feet wide, 56 feet high and 335 feet long. They are built under 1,200 to 1,750 feet of solid granite. A paved, 4,675-foot tunnel links north and south portals to the complex.

Key to the control operation in the mountain post is a specially designed command and control system. It is based on the speed and reliability of electronic computers which receive, process, store and display air defense information. Millions of pieces of information are stored in the NORAD computers.

At the heart of the complex, computers create displays of information gathered from the many outposts. Without leaving his chair, an operator can build a display of the U.S. and Canada that will show tracks of suspected or known enemy air activity, along with the tracks of orbiting satellites and the positions of foreign ships and submarines at sea. The display will also show the status of interceptor and missile weapons available to NORAD.

In the event of an actual attack, the display would show nuclear detonation locations and damage to air defense bases. The computer would predict time and impact points of intercontinental ballistic missiles and

—by backtracking the ballistic arc—their launch points.

Using extremely fast photo-processing equipment, the NORAD battle staff can watch an aerial track at almost the same time it is being made by the tracked object.

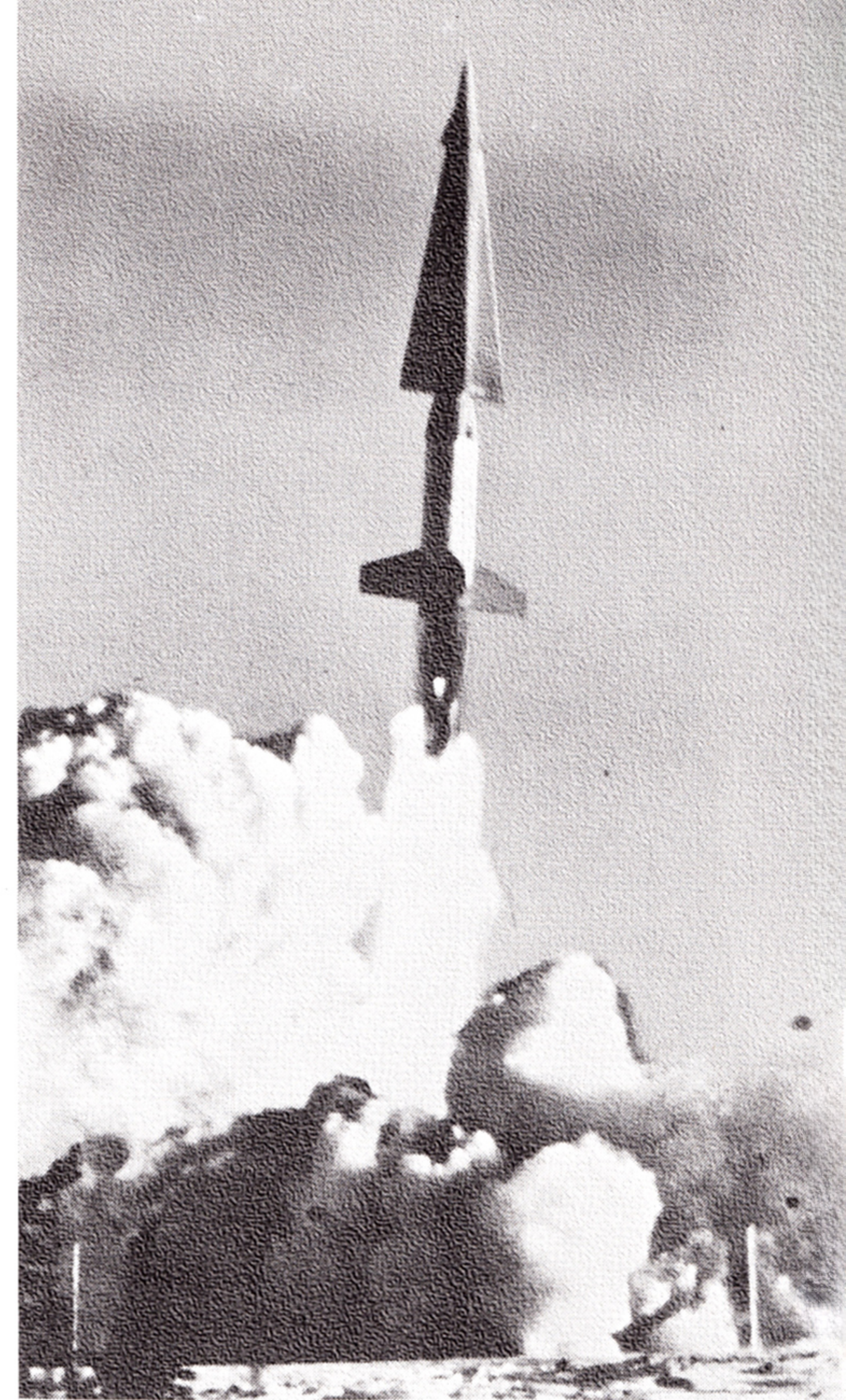
Information from a Distant Early Warning site in Greenland or the Ballistic Missile Early Warning System radar in Alaska, for example, flows through the computer and onto display consoles without ever being processed by human hands or brains, and it can be done so speedily that it happens in real time.

The time lag between detection of an aerial object and transmission of track data for processing and display by the computers is measured in fractions of a second.

In addition, there is equipment to provide this picture to all the air defense officers who are manning the command post. This picture is projected on a 16- by 20-foot screen within a total elapsed time of 13 seconds after the picture is flashed on a console.

The NORAD concept of aerial warfare is a family of weapons providing defense in depth. The aim is to subject an invading force to continuous attack from as far out as possible as it approaches a target area. An enemy bomber would first be attacked by long-range manned interceptors, next by pilotless interceptors of the Bomarc type, and finally by Nike Hercules and Hawk missiles.

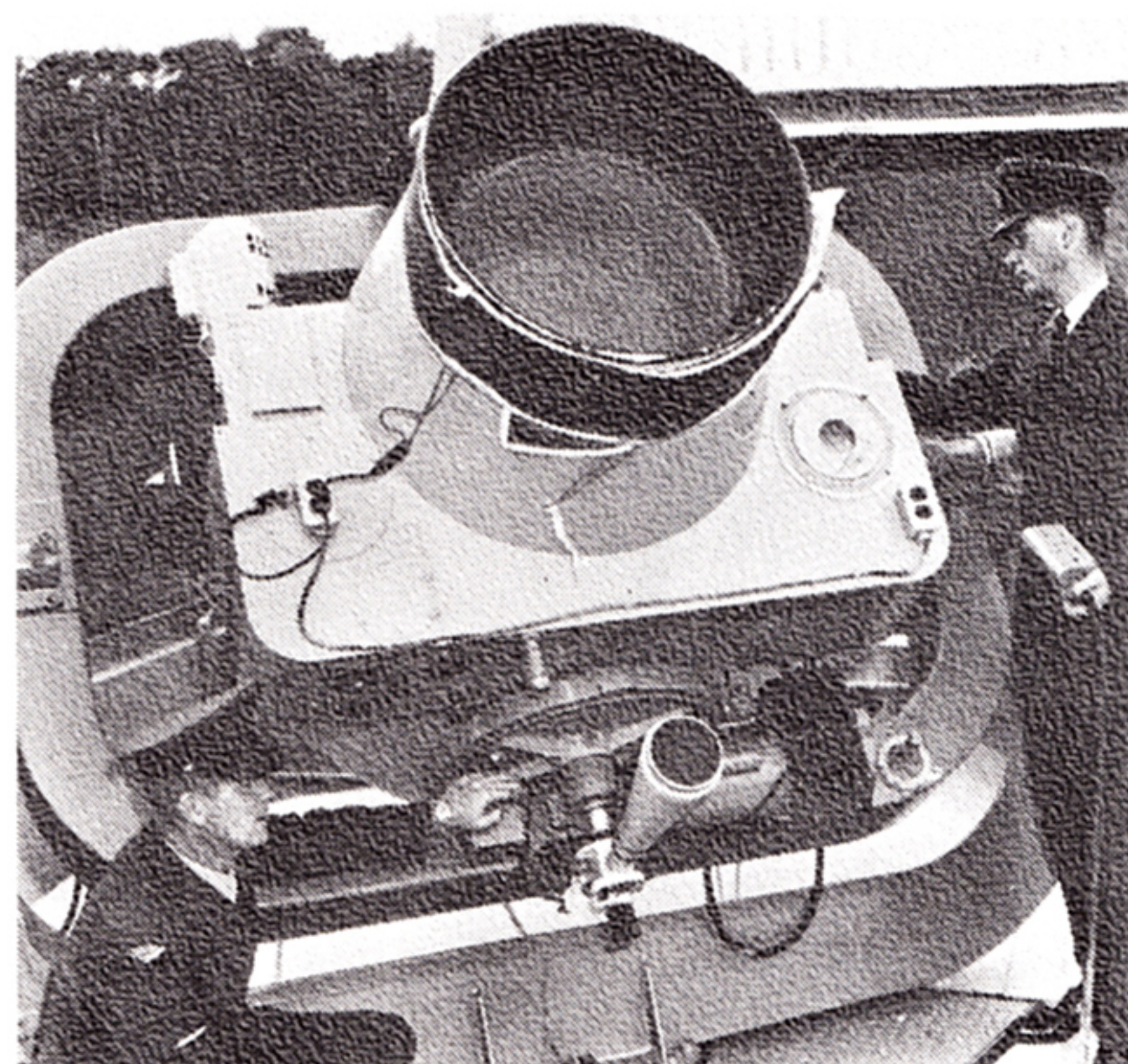
While all services—Army, Navy and Air Force—work together in air defense operations, it is the Army's job to keep the last line of defense prepared for action. That means



constant training by Nike and Hawk units, mostly at Fort Bliss and McGregor Range.

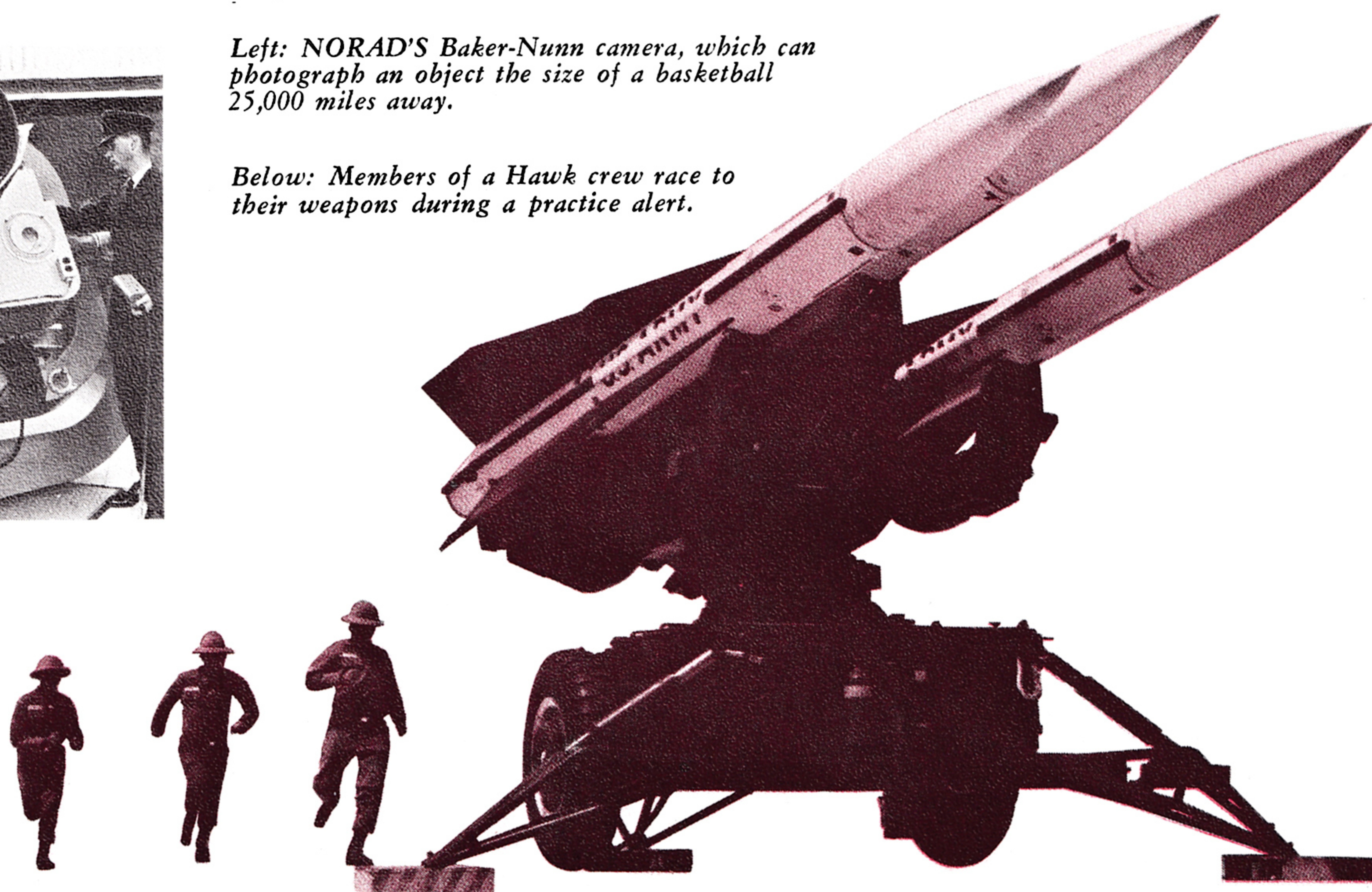
McGregor Range is a familiar place to missilemen from Air Defense units across the country. At McGregor, they regularly carry out missile firings at target drones, such as the Firebee or Towbee. Competition is knife sharp between various units, and the scores they win at McGregor mark them for several months.

There is a spirit among missilemen and the soldiers at Fort Bliss that is rarely seen in the civilian world. They give a lean, sharp impression from recruit on up.



Left: NORAD'S Baker-Nunn camera, which can photograph an object the size of a basketball 25,000 miles away.

Below: Members of a Hawk crew race to their weapons during a practice alert.



Left: A Nike Hercules at blastoff.

Right: Gen. Raymond J. Reeves (USAF), NORAD commander, and Lt. Gen. W.R. MacBrien of the Canadian Armed Forces, deputy commander.

Below: The electronic display room, where NORAD keeps watch on the sky and space.



site. Unlike conventional radars, which use mechanical antennas to form and steer their beams, MAR does the job electronically.

In MAR, radar beams are steered, or bent, at their source. Because of the speed at which this electronic switching occurs, the radar can, in effect, look in every direction at the same time.

This new type of radar is being designed as the primary radar for the nation's antiballistic missile system, using separate antennas for transmitting and receiving. Only the antennas would be above ground, enhancing the radar's ability to survive a nuclear attack. The radar is being designed to perform functions that previously required four separate radars — target detection, discrimination, tracking, and interceptor tracking and guidance.

For the Buffalo-Niagara group, Operation Understanding began on a Monday and ended the following Saturday. Their host was Lt. Col. Ulysses X. White, commander of the Buffalo-Niagara area's 101st Artillery Group (Air Defense).

In six days, the travelers had flown thousands of miles and had viewed a wide cross-section of the nation's air defense men and equipment. Each of the civilians brought back several military mementos — including an official Oozlfinch diploma — named after the bug-eyed, backwards-flying guardian bird of the missilemen. ■

"Young Americans who drag their feet get all the exposure," Gen. Underwood told the Buffalo-Kansas City group. "The young recruits you see here are the ignored majority."

Said the general: "I feel deeply about these fine young Americans."

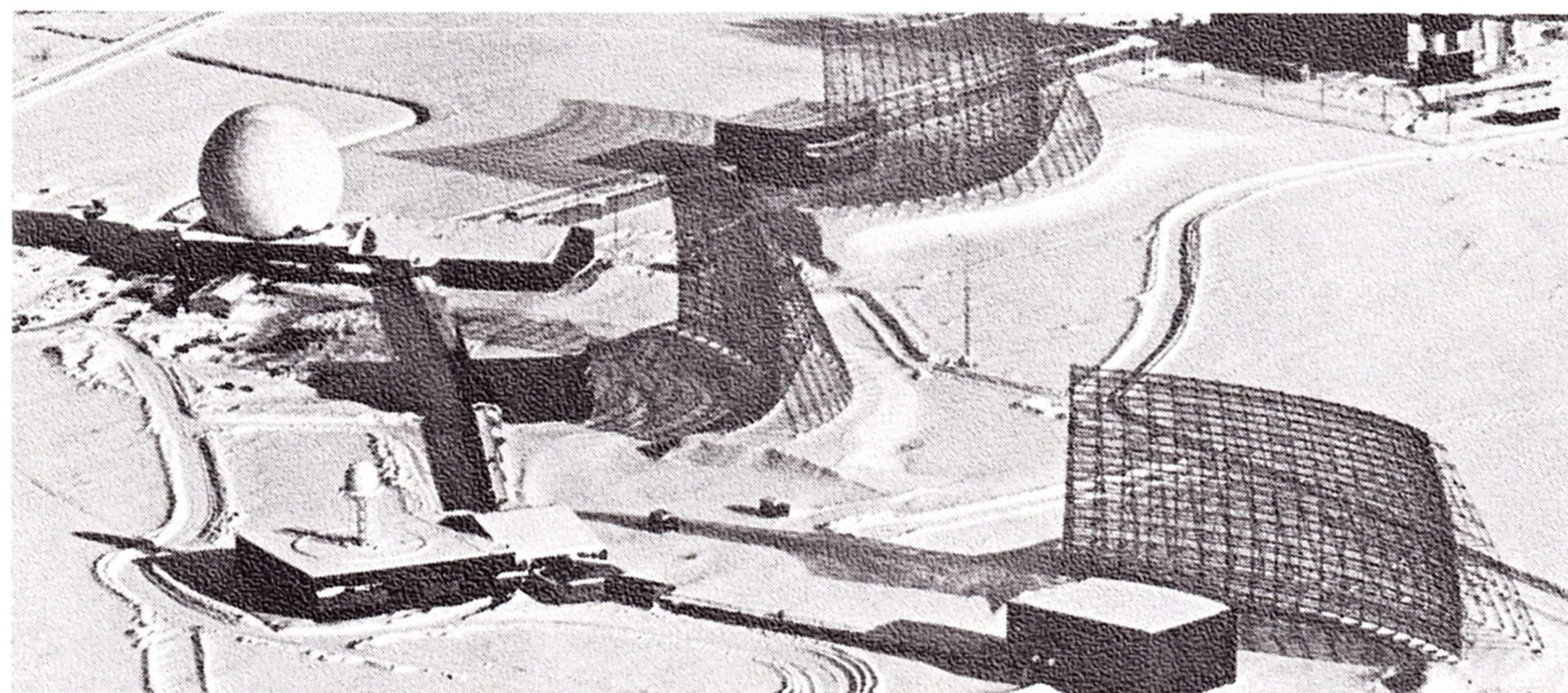
Research on new missiles and support systems is the chief activity at White Sands Missile Range just north of Fort Bliss. White Sands occupies a land area of about 100 miles by 40 miles, with a leased range extension 40 miles square on the northern boundary.

Operated by the Army, the giant range supports missile test programs

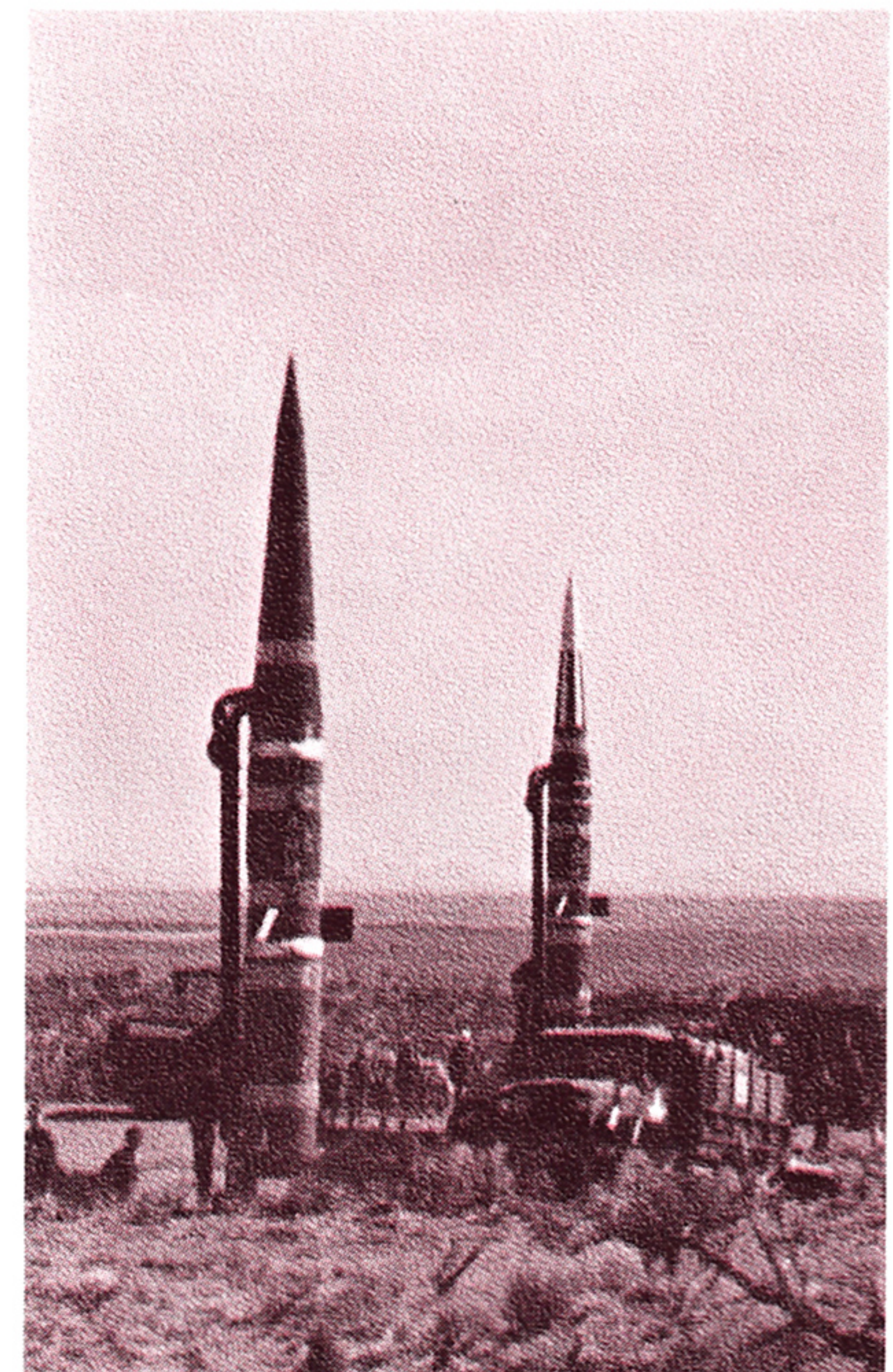
of the Army, Navy, Air Force, Department of Defense and the National Aeronautics and Space Administration. The range contains more than 1,100 precisely-surveyed sites for permanent and temporary instrumentation locations.

About 700 optical and electronic instruments of the latest types are available at White Sands for support of range-users' data requirements. Many of these are mobile, for off-range support, and for use at temporary sites on the range.

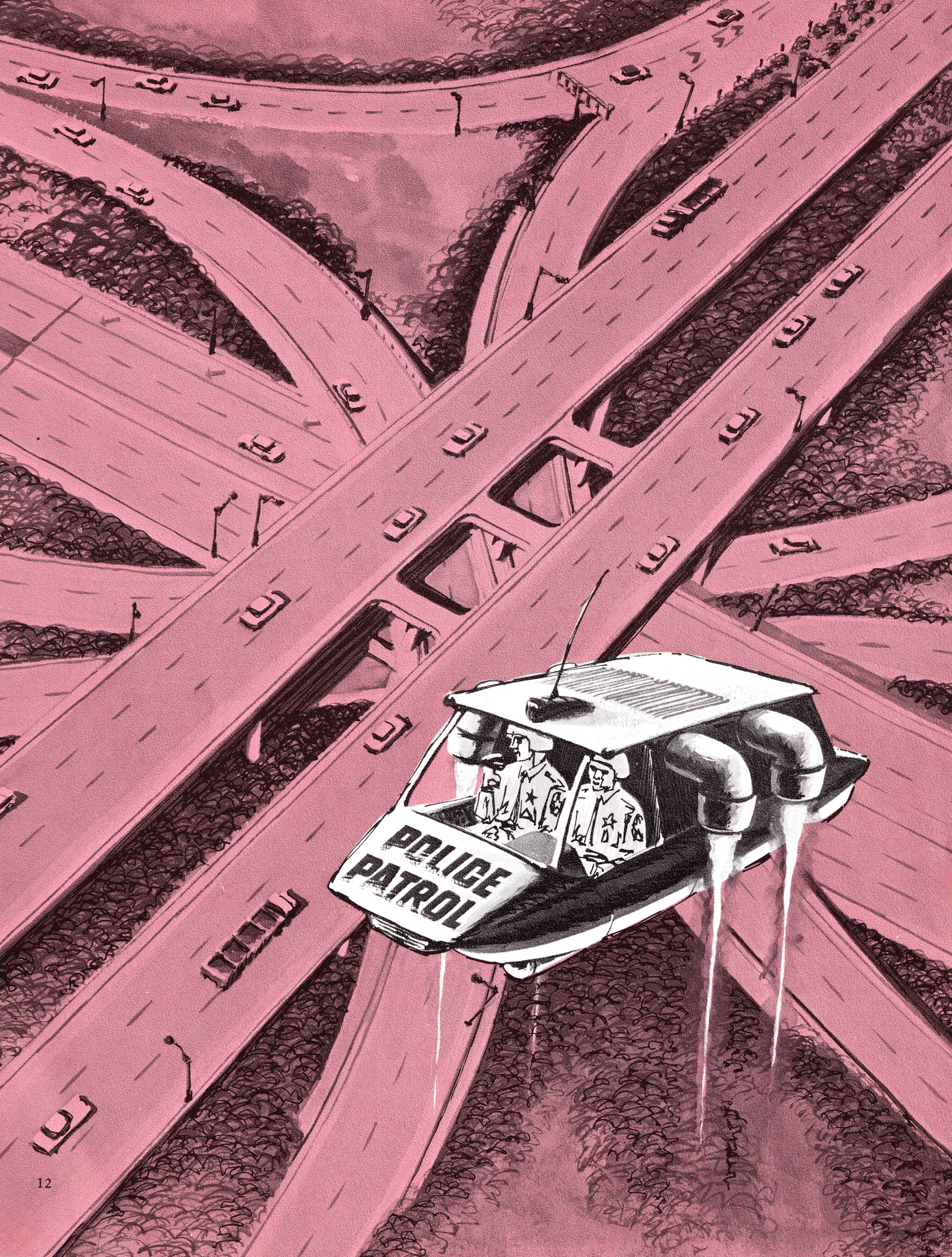
Among the most advanced pieces of equipment at White Sands is a Multi-function Array Radar (MAR)



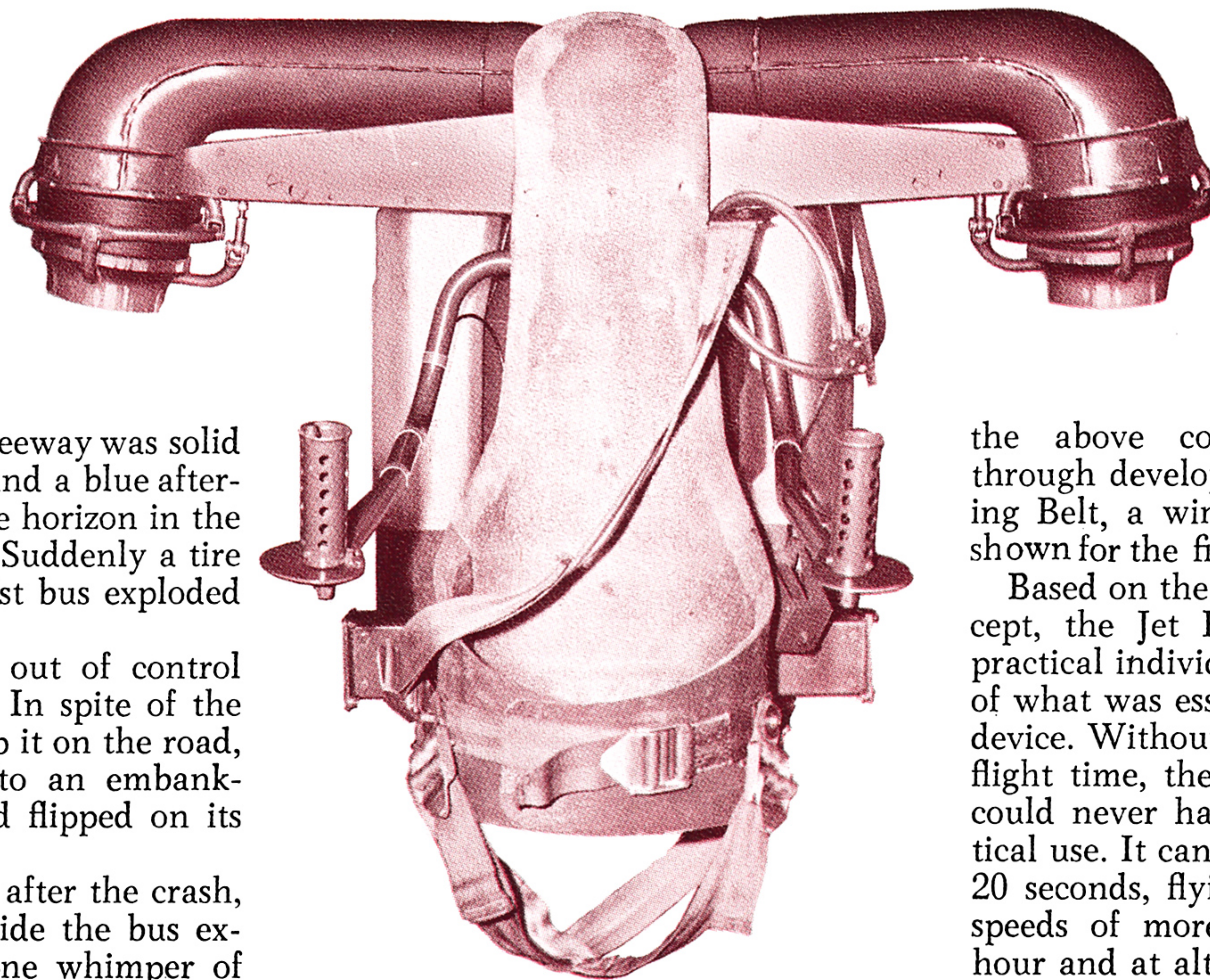
Radar antennas of the Ballistic Missile Early Warning System that throw beams over the top of the world.



Pershing missile launch site near Blanding, Utah.



THE WINGLESS JET SET



TRAFFIC on the freeway was solid and moving fast, and a blue afternoon haze blurred the horizon in the direction of the city. Suddenly a tire on the crowded tourist bus exploded like a cherry bomb.

The vehicle went out of control almost immediately. In spite of the driver's efforts to keep it on the road, the bus slammed into an embankment, rebounded and flipped on its side.

In the first instant after the crash, there was silence inside the bus except for the thin, lone whimper of an infant.

On both sides of the freeway, traffic shuddered to a halt in a massive tieup. At first, passengers in cars near the crash scene sat dumbly and gaped at the sight, while vehicles halted down the road blew their horns in annoyance.

"Thank God it didn't burn," mumbled the bus driver as he hoisted himself on his elbows out a window. Dazed, he looked back inside and without thinking, shouted, "Better get out, it might burn!"

There was panic, and dozens were injured in a fierce scramble toward daylight.

In a brightly-painted television news car trapped by the traffic nearby, a newsman reached for his camera, hesitated and then grabbed his radio telephone.

"It's on the freeway 10 miles out of town," he shouted. "Terrible crash. Get the police here fast as you can. Get a doctor. Ambulances. Fast."

The desk lieutenant sized up the situation immediately. The only way to get help to the scene fast was by air, over the rooftops of the traffic. He dialed 473—the number for the department's air mobile unit—and two minutes later jet engines whined

In one of the important aerospace developments of the century, the Bell Rocket Belt concept is coming of age. Several recent innovations based on the famed flying system show the tremendous potential of the concept, which like the airplane started out as a novelty but is gradually growing into a useful, accepted form of transportation.

on the roof of police headquarters.

Two Jet Flying Platforms lifted off, tilted slightly in the direction of the freeway and sped off toward the crash. When they touched down in the tiny opening on the highway next to the bus, a young police doctor jumped off immediately. In the excitement, he had forgotten to fasten his safety belt.

Within minutes, the Flying Platforms were ferrying injured persons to a nearby hospital, while the doctor—calm now, doing what he was trained to do—treated passengers who needed immediate medical help.

The toll: 33 injured, but no deaths. While visualized for the future,

the above could become reality through development of the Jet Flying Belt, a wingless flying machine shown for the first time this year.

Based on the Bell Rocket Belt concept, the Jet Flying Belt makes a practical individual mobility unit out of what was essentially a fascinating device. Without increased range and flight time, the Rocket Belt concept could never have been put to practical use. It can stay aloft only about 20 seconds, flying up to 860 feet at speeds of more than 60 miles per hour and at altitudes over 120 feet.

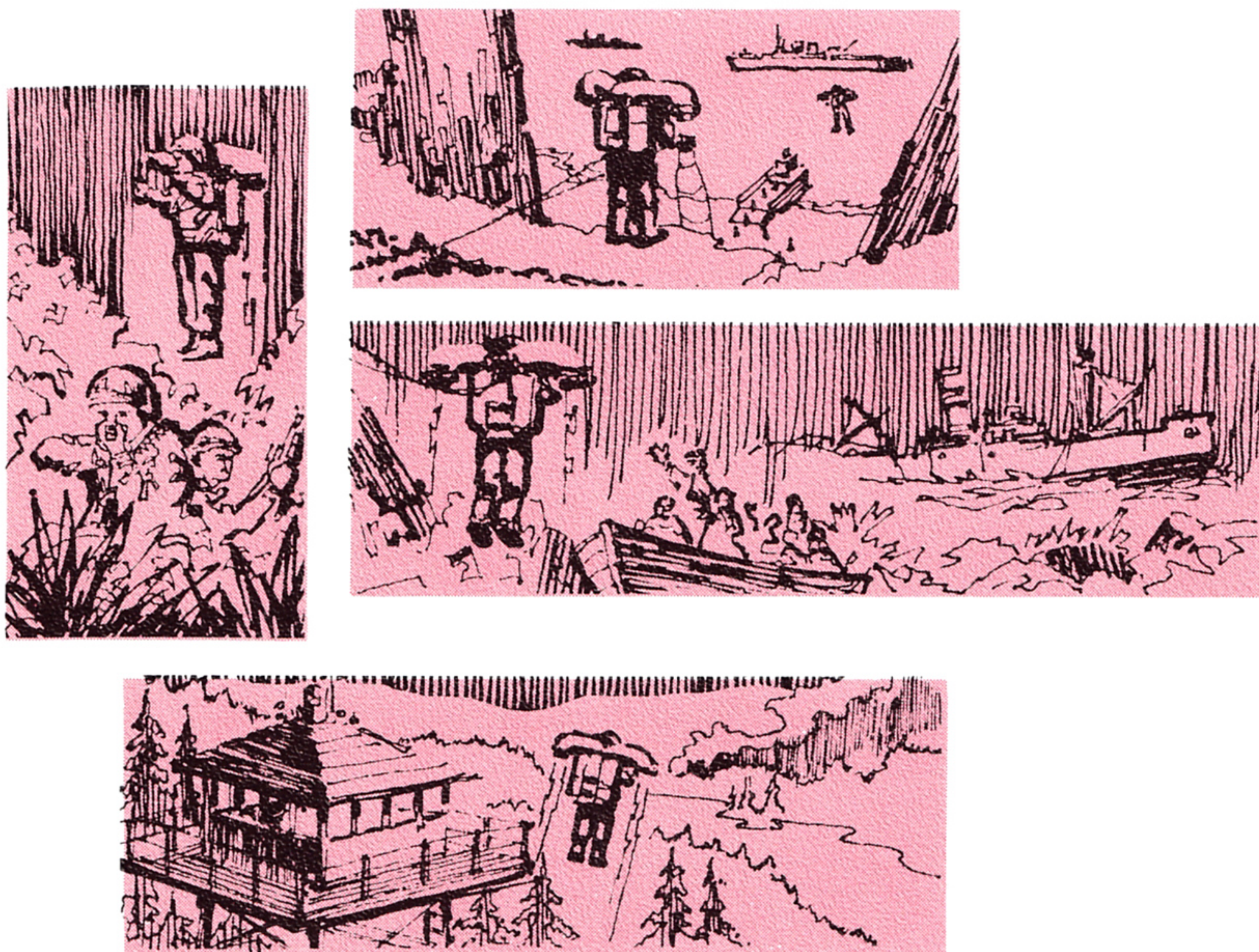
The Jet Belt is an improvement in every way. And while details of the machine's performance are classified, Maj. Gen. Don R. Ostrander (USAF-Retired), Bell's vice president-planning, said last summer:

"The improvements are very significant, and we can now talk about range in terms of miles rather than yards."

Propulsion for the Jet Belt is supplied by a small bypass turbojet engine developed by the Williams Research Corp. of Walled Lake, Michigan, under subcontract to Bell Aerosystems. Designated the WR-19, the engine was designed and developed specifically for the Jet Belt, and as such has a high thrust-to-weight ratio and low fuel consumption. The engine measures about one foot in diameter and two feet in length.

The Jet Belt system operates in much the same way as the Rocket Belt. Thrust from the jet is channeled equally through two nozzles pointed downward just behind the operator's shoulders.

For liftoff, the operator turns the right hand motorcycle-type handle grip to increase thrust. He controls flight by manipulating the thrust nozzles with hand and arm motions. Thus, by tilting the nozzles back-



ward, the Jet Belt operator will move forward in flight at a speed depending on the amount of thrust deflection he applies to the nozzles.

The operator has complete freedom of flight. He can perform such aerial maneuvers as flying forward, backward, sideways, rotating on a vertical axis, coordinated turns and hovering at a standstill.

Development of the Jet Belt is being sponsored by the Defense Department's Advanced Research Projects Agency (ARPA) under a contract by the U.S. Army Aviation Materiel Command. And among the military applications being considered for the new machine are mine field clearing, reconnaissance, counter-guerrilla warfare, assault, perimeter guard and communications tasks.

The scope of possible civilian applications is even wider. They include riot control, powerline and pipeline patrols, microwave tower inspections, photographic news coverage, fire inspection, rescue operations and traffic surveillance.

The Jet Belt can go where no other vehicle can travel. One version of the machine—the Flying Platform

—can lift stranded persons off the sides of cliffs by letting them step aboard the hovering platform.

And since the system does not rely on aerodynamic surfaces to stay aloft, it does not depend on calm air for a smooth flight. The turbulent air near a fire, for example, would have little effect on the Flying Platform since it has no wings or flying surfaces.

Use of the machine is in keeping with the continual updating of technology that is taking place within police and rescue organizations, and the military. Police have been using airplanes, for example, since 1929, and helicopters for the last several years.

A key to the successful development of the Flying Belt was the use of the bypass-type jet engine. In this engine, part of the intake air is deflected through a chamber that surrounds the engine. This bypass air follows the flow of hot jet gases inside the engine, and is again mixed with the primary air flow in the thrust duct. Thus, the bypass air keeps engine heat from radiating outward to the operator and the fuel tanks.

The fuel is carried in clear plastic

tanks which wrap around the engine. The engine burns ordinary kerosene-type jet fuels, and the amount of fuel remaining can be checked visually through the tank walls.

A simple device serves as a starter for the Jet Flying Belt. It is an explosive charge something like a shotgun shell. Triggered by the operator, the charge ignites a solid propellant which exhausts through the engine, spinning the turbine and igniting the jet fuel.

Inventors of the Flying Belt are John K. Hulbert, chief of gas turbine engineering, and Wendell F. Moore, assistant chief engineer at Bell. The company received a U.S. patent for the invention early in 1966.

Co-inventor, with Moore, of the Flying Platform and Flying Chair versions of the Jet Belt is Edward G. Ganczak, research associate. Robert J. May is project manager for the Jet Belt program.

Moore is also inventor of the Rocket Belt, which since 1961 has achieved 100 per cent record of reliability in more than 3,000 flights throughout the world.

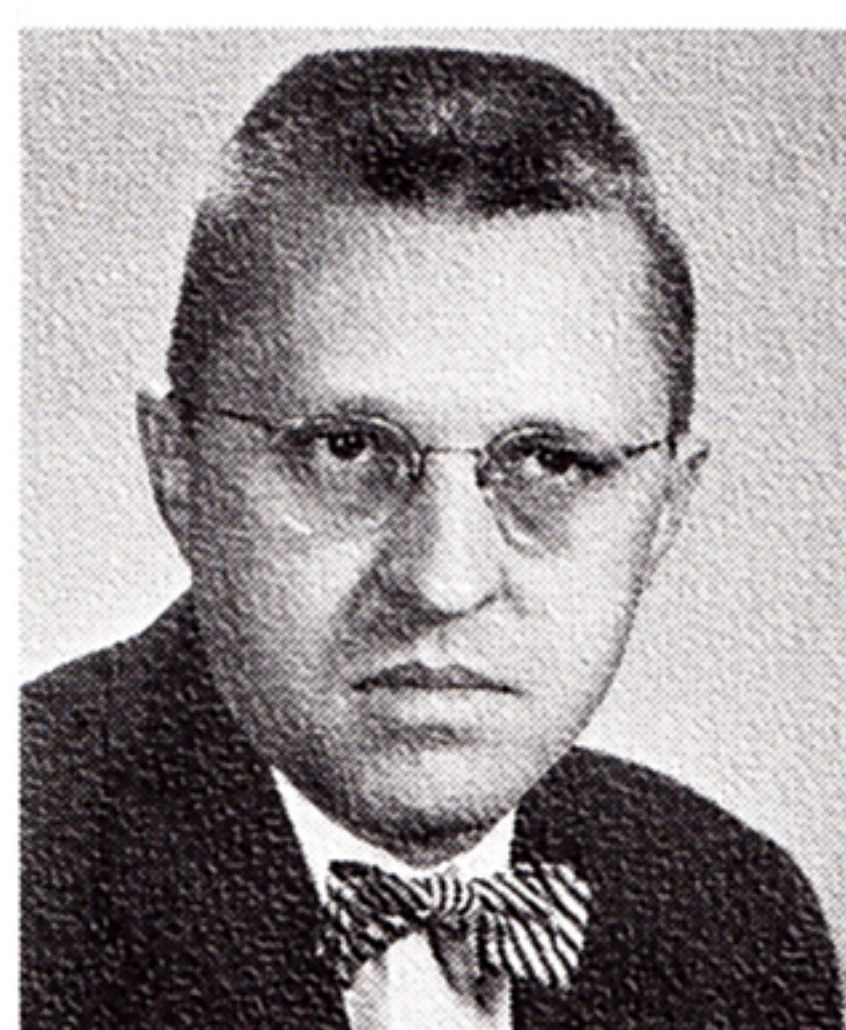
The Rocket Belt uses a hydrogen peroxide propulsion system, with fuel stored under pressure in two tanks behind the operator's back. When activated by the controls, the fuel is forced under pressure into a gas generator where it contacts a silver catalyst bed and decomposes into steam. The steam escapes through rocket nozzles providing the thrust, with the main force of the thrust directed toward the ground while jet deflectors provide thrust for yaw control. Pitch and roll are controlled by movements of the operator's shoulders.

The Rocket Belt, first flown on April 20, 1961, is known to millions of persons in the U.S. and abroad through its performances at such events as fairs and sports events. This program of demonstration has helped finance development of the flying system.

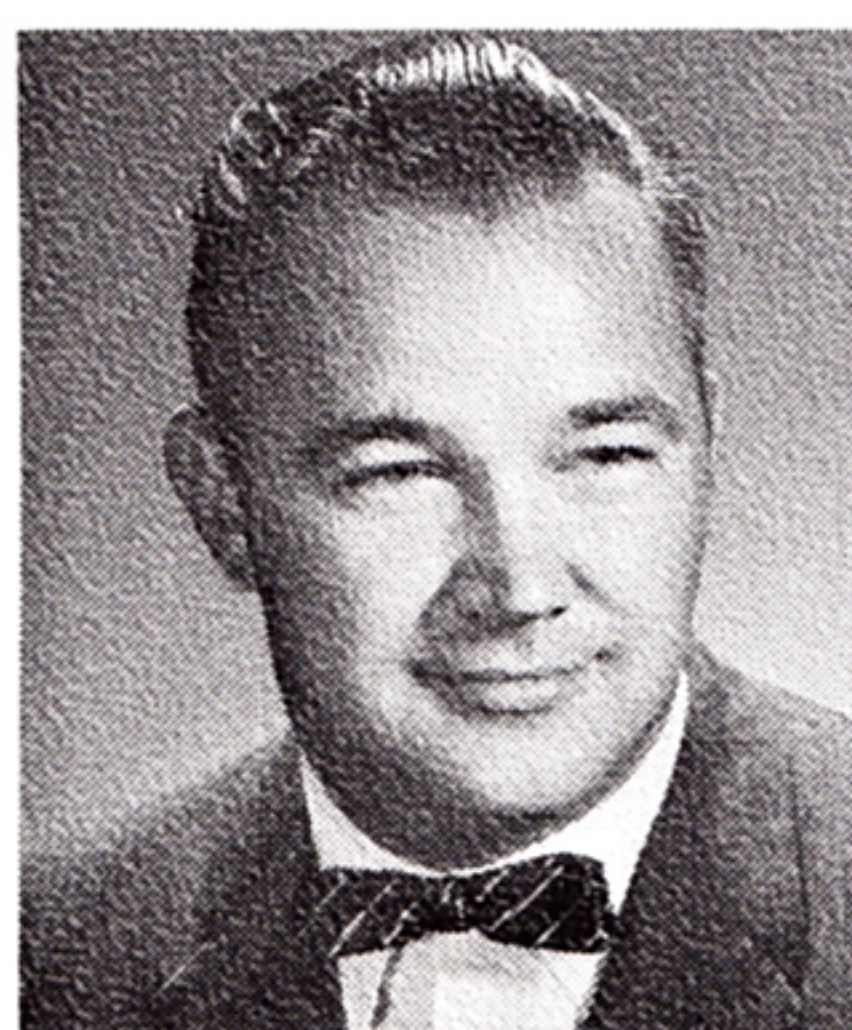
In almost the same way as the early airplane, the Rocket Belt is a born crowd-pleaser destined for a practical future of service to mankind. ■



Wendell F. Moore



John K. Hulbert



Edward G. Ganczak



Robert J. May

The Data Chief

DATA processing was a slow-moving business 17 years ago when Raymond E. Carroll joined Bell Aerosystems.

"In the early days," said Bell's director of Electronic Data Processing (EDP), "we had a calculator that could handle 100 computations a minute. Boy, were we proud!"

Today's EDP whiz-kid machines are among the best available in the world, and some of them can do a million mathematical computations in *one second*.

"It's been a tremendous experience," said Carroll, "to have been here at Bell through these years of growth in data processing."

A native of Watertown, N. Y., Carroll came upon Bell and his career in data processing by chance.

"I was a college mathematics teacher," he said, "when in 1951 I decided to take a job with the Cryptographic Service of the Joint Chiefs of Staff."

When he left his teaching post at Emory University, Atlanta, Ga., there was still a month to go before Carroll was to report for the Cryptographic Service.

He and his wife, the former Marjorie Gaylord of North Collins, N.Y., decided to spend the time in Western New York.

"That's what did it," said Carroll. "I met Dr. Everett Welmers, who was chief dynamicist at Bell then, was offered a job and accepted."

With a wink, Carroll remembered one of the reasons he decided in favor of Bell: "The job paid \$5 a week more than the government job did."

His initial assignment at Bell was work on the feasibility of the Auto-

matic Landing System—a project that in those days was in the research stages.

"I co-authored a technical paper called 'Optimum Landing System,' and served as assistant project engineer," said Carroll.

His work on the system that eventually was to be installed aboard all major U.S. Navy aircraft carriers, involved a good deal of time with analog computers.

When the study was completed in 1953, Bell had just organized an automatic computation group. Carroll was given a choice: Stay with the development program or take a job as a dynamics engineer working in the computation group.

"They needed my experience with analog computation," said Carroll. "I took the job."

By 1954, he was put in charge of a group that was operating a CPC (card program calculator)—a crude instrument by today's standards—and marveled at the machine's ability to handle 100 computations a minute.

In 1957, Bell computers were brought together in a new building at the company's headquarters plant, and in 1962 Carroll was named to his present position.

"One of the most challenging and interesting parts of this job," said Carroll, "is the diversity of problems we're called upon to handle here. EDP works on every major Bell program—including payroll."

He said EDP's simulators, which started with a "handful of small

cockpits," is one of the most impressive features of EDP today. These versatile simulators are used to study the designs and problems of vehicles that will fly over the moon, in space or in earth's atmosphere.

Although data processing has become Carroll's first love, he said he will always have a fondness for teaching.

He received a bachelor's degree in education from the former Albany State Teachers College in 1941, and taught high school mathematics and science until 1942 when he became a cadet in the U.S. Army Air Corps.

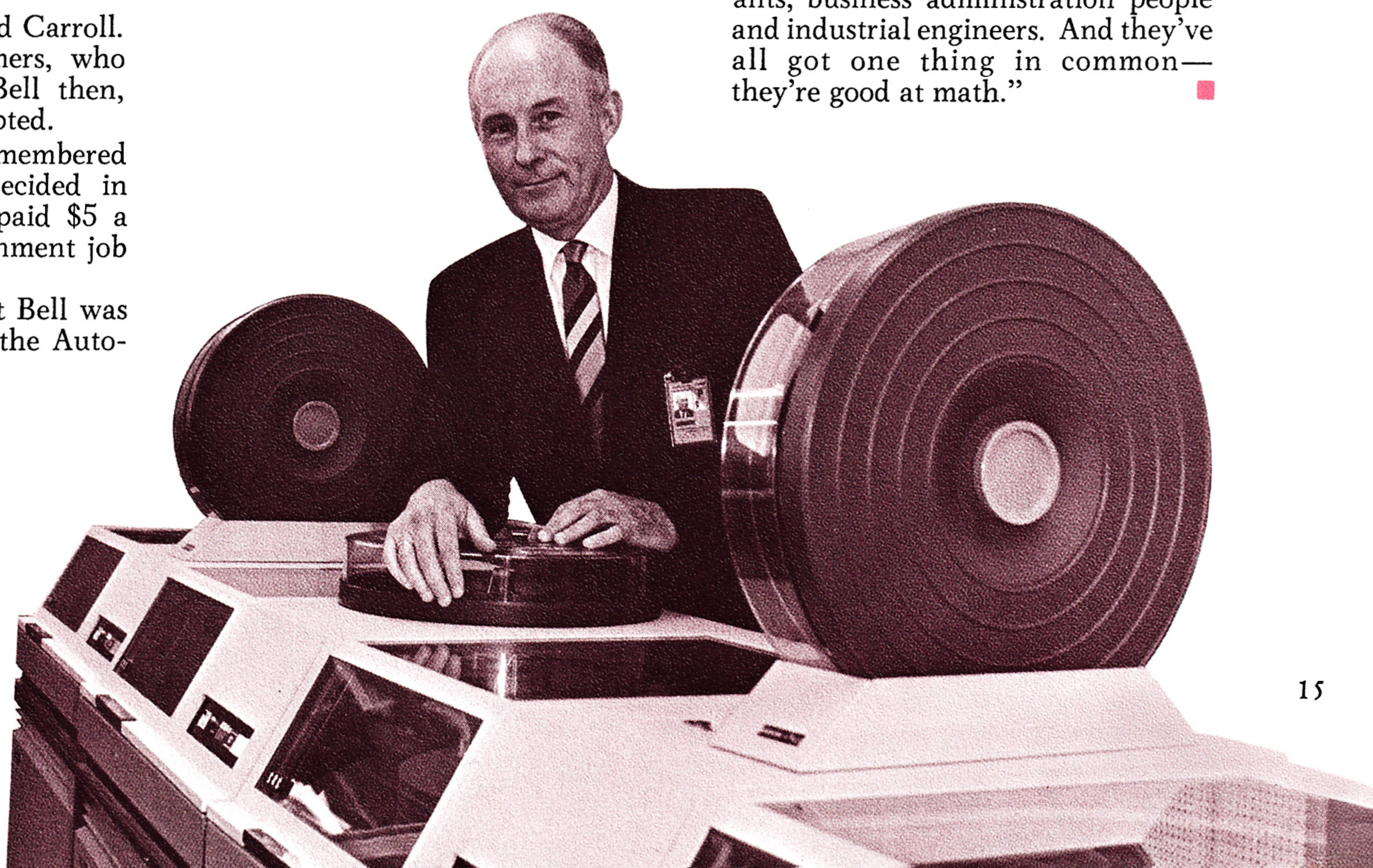
"I graduated from the Army's meteorology school in 1943 as a second lieutenant," said Carroll. When World War II ended, he returned to civilian life, and to teaching.

In 1947, Carroll took a job as mathematics instructor at the University of Illinois, continuing his own studies there at the same time. In 1949, he received a master's degree in mathematics and left for the teaching post at Emory.

Since then, he has continued school relationships. At one time, he taught night classes at State University of Buffalo, and he continued his studies through summer courses at Cornell University.

His son, John, is a structural engineer at Bell Wheatfield, and a daughter, Gayle, is a senior at the State University College at Potsdam, N. Y. Another daughter, Ellen, attends Kenmore East High School.

What does it take to work in EDP? "All types," said Carroll. "We've got mathematicians, physicists, accountants, business administration people and industrial engineers. And they've all got one thing in common—they're good at math." ■



ANNOUNCEMENT

The continuing need for the one thing that is constant in the aerospace business — change — last month produced a realignment of certain key executive personnel at Bell Aerosystems.

The realignment was the first at Bell since 1964, when the company shifted from management along divisional lines to a unified functional organization.

"Change is a way of life in the aerospace business—it's about the only thing that is constant," Bell President **William G. Gisell** said during the 1964 realignment.

"Professional management," he said, "implies a willingness and readiness to adapt and change when necessary to meet new challenges and, through planning, to anticipate changes."

The realignment last month coincided with an announcement in Providence, Rhode Island, that the board of directors of Textron Inc., Bell's parent firm, had elected **Robert S. Ames** of Bell a Textron vice president.

Ames had been Bell's vice president for manufacturing since September, 1964. His new position, which he assumed in Providence this month, makes him responsible for several Textron divisions.

President Gisell appointed **William S. Nochisaki** to succeed Ames. Nochisaki had been executive director of manufacturing since January, 1967.



Robert S. Ames



William S. Nochisaki

Other new assignments announced by President Gisell: **Lawrence P. Mordaunt**, vice president-marketing since August, 1964, to vice president and manager of the Minuteman III program.

John H. van Lonkhuyzen, Minuteman vice president for the last two years, to vice president-research.

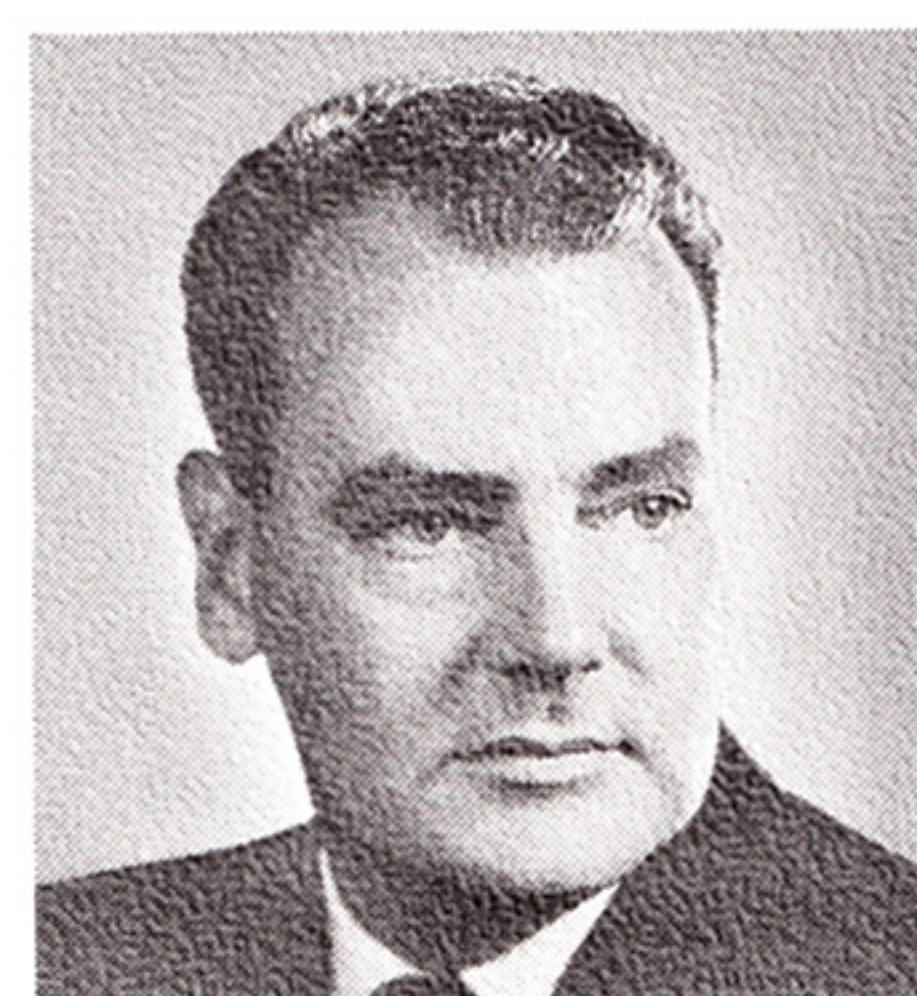
Dr. Clifford F. Berninger, formerly vice president-research, to vice president-engineering.

Joseph R. Piselli, who had been vice president-engineering since August, 1964, to vice president-marketing. Said President Gisell:

"These changes are part of our long-range manage-

ment plan to reassign our top level executives from time to time to different functions and responsibilities within the company.

"All of these men have proven their management abilities in their former positions. These transfers will give them still broader understanding of overall company operations. Likewise, they will bring to their new assignments the depth of experience accrued over the years at Bell and elsewhere in the aerospace industry."



Lawrence P. Mordaunt



John H. van Lonkhuyzen



Dr. Clifford F. Berninger



Joseph R. Piselli

Four executive directors were appointed in connection with the management realignment. They are:

John R. Clark Jr., who has been director of Bell's Eastern Region with headquarters in Washington, named executive director of marketing.

A. Bruce Horton Jr., who recently received his master of science degree in management from Massachusetts Institute of Technology under the Sloan Fellowship Program, named executive director of engineering. Horton formerly was manager of Bell's Arizona Operations.

Gerald S. Rosenfelder moves from executive director of marketing, a post he held for more than a year, to executive director of project and systems management.

Adolph Kastelowitz was appointed executive director of manufacturing to succeed Nochisaki. He has been associated with Bell for about three years, and has held various manufacturing and program management positions.



John R. Clark Jr.



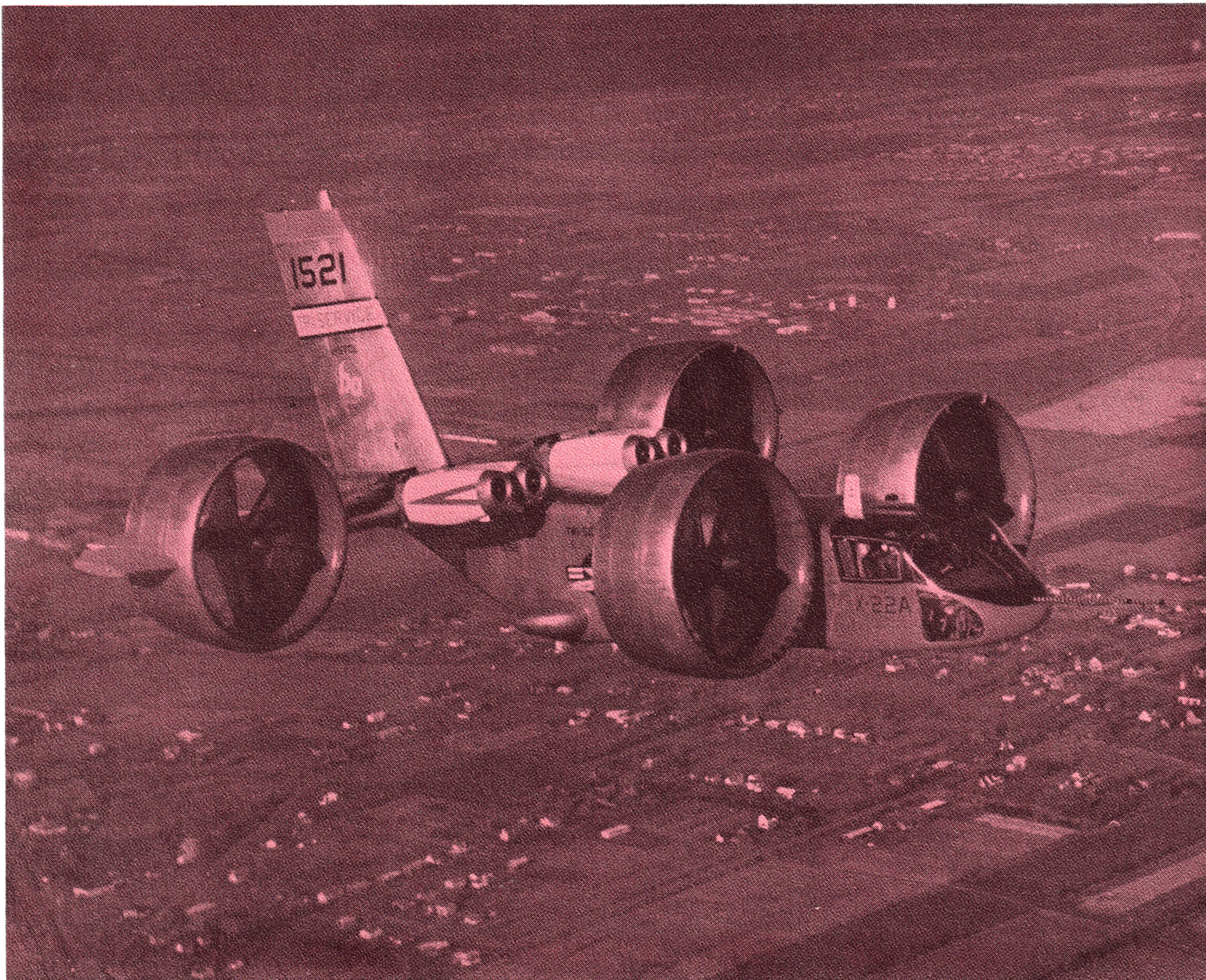
A. Bruce Horton Jr.



Gerald S. Rosenfelder



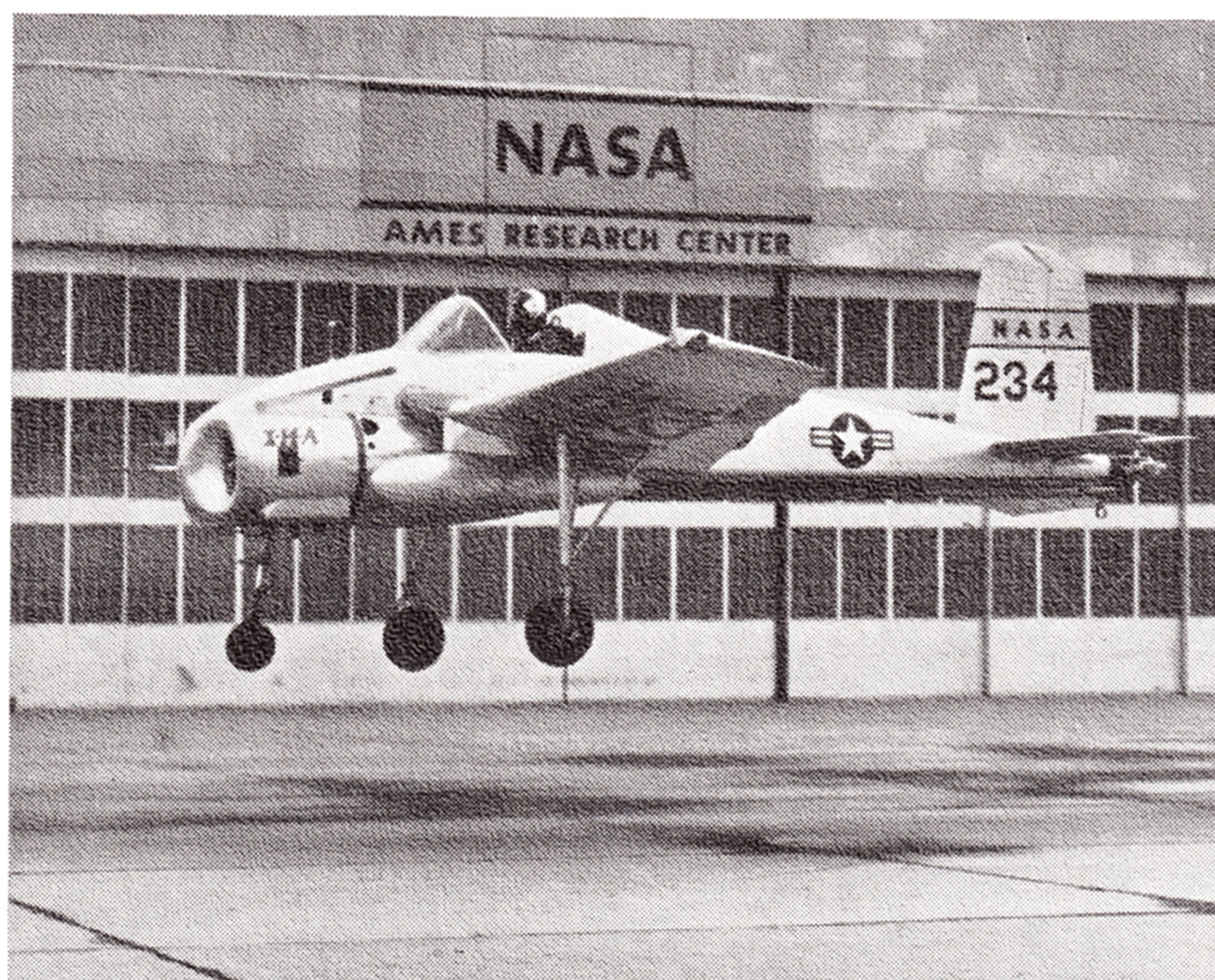
Adolph Kastelowitz



Ten years of *V/STOL* Leadership

BELL'S X-14 made history in 1958 when it became the world's first jet aircraft to take off vertically, transition to normal horizontal flight, then hover and land vertically. Developed by Bell for the U.S. Air Force, this pioneer V/STOL was delivered to NASA's Ames Research Center in 1959 and modified to the present X-14A version.

BELL'S X-22A marked another giant step in V/STOL development. Designed and built by Bell for the Tri-Service V/STOL Research Program, this dual-tandem, ducted propeller craft made its first flight in 1966. The X-22A has since completed its 147th successful flight, and more than 874 takeoffs and landings plus 94 transitions. Its variable stability system permits changing of flight characteristics while airborne to simulate various V/STOL configurations.



STILL FLYING after ten years, the X-14A used for V/STOL training, including lunar landing approach simulation, and stability and control evaluations, will now enter new programs of variable stability systems research.



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